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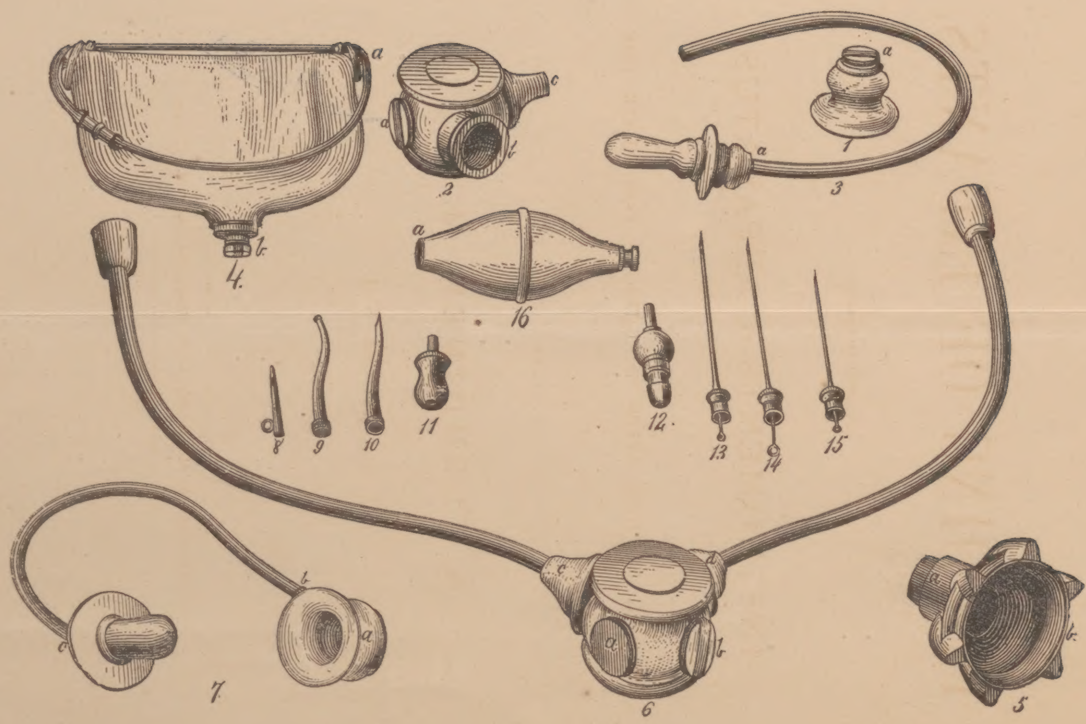
artificial feeding of infants.

A. Clendinen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ARTIFICIAL

FEEDING OF INFANTS,

AND DESCRIPTION OF

INSTRUMENTS & APPARATUS

OF THE AUTHOR, WITH DIRECTIONS FOR THEIR USE.

BY

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Artificial Feeding of Infants.

BY A. CLENDINEN, M. D.

First: as to the necessary or proper time for its administering.

In the fact of the death of mother or cessation of her milk supply, or other direct demand for nourishment, if expense does not debar, the wants of the babe should be, by a healthful, cleanly, sober, wet-nurse, attended to, nature's supply being entitled to more credit for propriety and reliability than can be uniformly expected from the best intending *cuisine*. In this connection I would say that said wet-nurse should be not more than three months past conception, if at all; the same rule applies to the mother. Our duty is to the individual well-being of each, child and mother. My experience has taught me as above, and also that in no case should her milk be allowed to be absolutely depended upon by the child more than eight months. There are cases, and more than supposed, when from inscrutable causes, the mother's milk, and sometimes even that of an apparently healthful wet-nurse is *mal a propos.* The temperament of the nurse may be too sluggish or too nervously irritable, or from the disproportionate calibre of her mammary blood vessels, or the constricting power of encircling muscles, too much milk may at a time be given or retained, to be at next nursing, too dense. With all the talents and appliances that any of our profession possess, to analyse the milk, whereas it may apparently be chemically "all right," it is manifest it may be unsatisfactory and deleterious. These remarks apply most to the mother, manifestly when she has a faulty diathesis, but again, if not apparent, as in an undemonstrated rheumatic diathesis. The crossing of equally good families in the nursing is advantageous, viz: when there are two apparently equal mothers, for the healthful, physical growth of the children, it would be better that they exchanged breasts. The same rule should, when possible, be applied to the human family as is applied to the horse, dog or fowl stock. A game keeper who knows enough will cross and re-cross his game fowl, otherwise they will soon lose their bone and muscle, and deteriorate, in shape, weight and ability. The same applies to horse

flesh; and in the human family, not only another mother should if possible be used, but the surest test of an acceptable wet nurse is in the finding of the woman, whose past nursing demonstrates, not only that through her nursing the child was thoroughly developed and that she, throughout, maintained a healthful appearance; but in addition, that her mammæ had maintained more tractive power upon her system than all other organs, as evidenced by the richness of her milk and her comparative thinning in spite of full appetite, full regulated diet and exercise.

There being many social and other objections to the wet nurse, we return to the *artificial* feeding. This should often be done when the mother lives, in order not only to not re-implant or foster a faulty diathesis, but also in cases where the main nutriment is retained by the mother to the cost of the child; this is often seen in the *embonpoint* of the mother and the rickety anæmia of the child; in other words, whenever the child is evidently poorly nourished. If, with our litmus paper to test the acidity of the milk, our lactometer, to find its general specific gravity, Donné's, to find by the relative color of the thin milk layers, the quantity of butter, and consequent apparent heat power on oxidation in the blood; it being claimed that these fats occasion the evolvement of five times as much heat as meat, three times as much as bread, and twice as much as sugar or farinaceous food: I say, that if after investigations and attempts to correct the found or not found trouble we fail, then the shortest and surest remedy is artificial feeding, and that with the bottle, unless in cases of hare-lip, cleft-palate, tongue-tie, or excessive debility. There are manifest reasons, why this is preferable to the spoon, or other mode. It is the closest simulation of nature's way, and inasmuch as in the child, anatomy and physiology teach us that the digestive line is more direct and less valvular than in the adult, consequent upon the non-distention of the inferior surface of the stomach, at cardiac end and the comparative non-valvular conformation of the entrance to the large intestine, therefore the suction of the mouth is in infancy necessary, in order to stimulate the scantily developed salivary glands to sufficient secretion; and this applies even to the stomach, whose acid generating end, the pyloric, has not rough food, as in the adult, to stimulate its secretions. These two sections of the line are essentially entitled to attention, the salivary glands being, as compared with biliary and pancreatic, but slightly developed, it is necessary to encourage the secretions of

the saliva, and nature has not only shown us how to do it, but shown us also that it must be so done, in order that the saliva may be furnishable on demand, viz: as the milk goes into the mouth the saliva must in nature's proportion, then and there, admix with it to convert the starch into sugar, etc. Although in the human milk there is normally little or no starch, and we, in imitating the food of nature, should especially at the commencement use as little as possible, and for the relatively necessary amount of sugar should mainly supply it already formed, nevertheless, experiment has proven that the salivary glands have (under normal suction) sufficient power at three months; and that at eleven they have as much as the adult; *Korowin*, St. Petersburg. Too much sugar in the ordinarily prepared bottle food is often the occasion of sore mouth of the babe. Routh says, that hardly ever is sugar in excess in human milk except in the watery milk of anæmic women. To the contrary, as a rule, when there is a disproportion, it consists in its deficiency; and here we would say that especially in connection with its solubility in water, the presence of the proper amount of sugar is required as accelerating the ultimate divisibility and digestion of comparative insolubles, as caseine, whose digestion has been started by the gastric juice being helped in its acidity by the lactic acid, formed in the stomach. Sugar, when butter is deficient, being convertible into the same, is thus capable, not only of acting as a solvent disseminant, but also as a lubricant (independent of the other qualities of butter). When the proper proportion of sugar is deficient, constipation is manifest, consequent upon slow transit and attendant inertia from lack of excitation to peristaltic action. We all know that too much molasses is too much of a fermentive cathartic, but when we are, as before stated, shown the appropriateness of sugar in the milk, we should see to its proper proportion in the artificial food. When there is too little sugar there will be too much undigested caseine, etc. Jacobi's dose of sugar, to relieve the costiveness, is one or two scruples, about two-thirds of a teaspoonful of loaf sugar dissolved in two teaspoonfuls of water, tepid, and given before breast nursing. The proper proportion of salt in the maternal milk, and therefore in the artificial, is to be closely observed; its normal stimulation of the mucous and glandular parts is early manifest. Its stomachic decomposition, and thus furnishment of the chief constituent of gastric juice, hydrochloric acid demonstrates its appetising and digestive power. The translation of said acid by the biliary soda into chloride of sodium

again, insures stimulation, so that the biliary organ be in condition to again on demand furnish its normal secretion. This chloride of sodium in its transfusive power is wonderful; combining with the albuminous matter and carrying the same, first into the cells to build them up, then solving the debris, removing the same and filling its place with fresh material. It is therefore the in and out transmutor. We know that if too much is taken in by the sailor, too much albumen and tissue will be thrown out, as in diarrhœa, scurvy, etc. .09 in a hundred parts is the average normal amount in breast milk, and should therefore be so supplied in the artificial. The other salts, the earthy and alkaline phosphates, next demand our attention, as first favoring digestion (before passing into the blood, and as in the muscles striking fire and generating steam for the acting of the same.

Farinaceous food is deficient in phosphates, and when substituted altogether or in part, for human milk, is often the cause of rickets—which is occasioned by excess of acids, which make main demonstration in their solvent power on bones. On the other hand, cow's milk, although it contains nearly twice as much of the phosphates as human milk—contains so much caseine and butter as to naturally be indigestible, and therefrom, by the generation of so much acid, dissolving out of the blood the proper amount of phosphates, it too,thus causes rickets. All this shows us how much care is necessary not to use a solution too strong of either farinaceous matter or of cow's milk, but to have it sufficiently aqueously diluted, (especially in summer), and with sufficient sugar and salt—and last, but not least—given at human milk heat, and at proper intervals. The artificial food should, in imitation of proper human milk, be feebly alkaline; and as to the cow's milk to be used in its admixture, I would just as soon use condensed milk, diluted according to its degree of condensation—generally 4 or 5 to 1. The fact of its being not from an individual cow, but from a general dairy, is to its advantage; and from its preparation and percentage of sugar, is not so liable to fermentation as regular milk. In reference to the alkalinity of the food we would again refer to physiology. When the food has passed from the stomach, its percentage of acid should, as before stated, be neutralized by the soda, etc., of the bile—thus giving it an essential alkaline character—thereby only enabling the pancreatic juice to decompose the fatty parts of the food—forming glycero-phosphoric acid, lecithine and phosphate of

lime. Principal among the alkalies is the phos. of soda, and most necessary to prevent acidity—which would estop the formation of bone and other tissue. In the bone formation the phos. of lime and the earthy phosphates play their part, and, according to Beneke, "no cell formation takes places without phos. of lime." Its proper proportion in the human milk is (0.25) one fourth of one per cent. When this proportion does not exist, and is not supplied, look out for bow legs and other malformations, where enough bony matter is formed to be deformed. From its deficiency, rickets, and all sorts of complications ensue.

In the artifical food, especially where what is prepared is not immediately to be used—in order to insure its sufficient alkalinity, not only in its ultimate action but to prevent its acid fermentation before use—*one or so teaspoons of lime water should be added to every pint of artificial milk food.*

All sorts of artificial feed are prepared and for sale, and the malt idea, and a great many other ideas are good, especially if lived up to, not only by the child, but by the selling merchant and the cook. I have used a number of these—prominent among them, and to the best of my knowledge and belief, most reliable—*Imperial Granum.* But my experience teaches me that the simpler the order I give, and the more come-at-able the material, the better. Of the grains—barley is the best, and should, if in an admixture, predominate, because it contains the largest per centage of the phosphates, .27, and the least of the starch, .483. Wheat, which contains the largest percentage of albumen, therefore takes a high rank—especially, if in a bag it is carefully hung and kept at boiling point for 8 or 9 hours, and when, then nearly dry, the starchy coat is pealed and scraped off, it will be found an elegant food. If it could be done, it should be boiled in and over rennet water, to which, if a proper percentage of salt is added, the dry cake, after being taken from the bag and the starchy coat removed, will preserve in condition for quite a while. Sufficient being scraped off as it is desired, can be used with $\frac{1}{8}$ milk and $\frac{7}{8}$ water properly sweetened.

In reference to barley, I prefer it fresh ground—at home—and I must not forget here to say that the oatmeal I often use in connection with it, especially in summer, by its extra percentage of butter enables me to do with less cow's milk, and to be thereby less bothered with the caseine of the same at that time when the digestive powers

are enfeebled. A precaution is necessary—that the artificial food be always finely strained through linen, so as, from its fine division, to render its proper proportion more immediately absorbable on entering the stomach; not only thus to avoid any continuous intestinal irritation, but so as not to, by topical irritation at the pyloric end of the stomach, cause too great acidity of the food upon its passage to the duodenum.

Speaking of stomachic indigestion reminds me of Schiff's recommendation of dextrine, and of Jacobi's suggestion of rectal injection of the same in the case of babies. The ordinary use of pepsin is good; the use of the infusion of calves' stomach in boiling the wheat flour, as before referred to by me, will often prevent the after call for pepsin. In reference to indigestion, it is especially noticeable in the babe in summer. Why? For the same reason as in the adult—with the addition that the babe has not only to maintain life, but also to increase its area—showing by the thermometer that extra heat is therefore required—in connection with, if not consequent upon which extra heat, is the extra rapid action of the heart. There is one thing patent to the eye, viz.: that paralysis of the motor nerves is found to have associated with it paralysis of the secretory glands—which are thus demonstrated to be under the same influence, and the temperature of the parts is decreased. In the matter of the temperature it is in active health; relative, comparative—but having its limits, and not to be calculated at any absolute scale. The alternation of cold and heat act when moderate as tonic stimuli—but too much heat acts like too much alcohol as a congestive depressant. Such effect upon the skin and lungs is manifest in their congestion and consequent inability to furnish sufficient oxygenated blood for the carbonic demands of the digestive and entire system—it is like cutting off the draft of a stove, and as this will cause the fire to smoulder and smoke, so with the child; its food is not perfectly combusted. Dalton's chemical action is all right—but not under a semi-vacuum, viz.: the comparative heat of the surrounding atmosphere, whereby there is rather an eflux current than an influx of oxygen to the child. The comparative heat of its body is not sufficient to cope with the surrounding air, and its inspiratory power not strong enough to mechanically, (as in a blacksmith's bellows) supply the oxygen demanded for its extra work. The result is the passive, congestive semi-paralysis of the skin, pulmonary and other surfaces, instead of the child possessing innate excess of heat

and therefore suctive power over the oxygen of atmosphere, and being at the same moment assisted in the influx current, by the pressure of the atmosphere. This latter pressure has in consequence of the atmospheric heat, and therefore semi-vacuum, been comparatively removed, and the currents are at last at a comparative stand still; congestive, if not absolutely efflux in character, the sweat, diarrhœa, etc., being evidence thereof. After refrigerant application at the point *d'appui*—base of brain, by conformable cap, of connected continuous rubber tubing, we should cool the respiratory surfaces of the lungs and skin, by the inhalation of cold air, even as by the oscilating of the fan, and the frequent use of the bath, are well; but, where it can and will be done, spray atomization will prove much better. 1st. It will not wash away the blood, viz.: sweat, and thus debilitate, but to the contrary will not only positively lower the surface temperature, but by thus doing so, will apply a local stimulus to the nerves, and thereby enable not only absorption, but this nervous tone will to inner sections be transmitted. And here I would say that if alcohol is allowed to be used, this is the way to use it. It will be more generally diffused and not act so radically upon one section, the digestive canal—and even if only used in connection with water in sponging where they won't or can't use spray, its more rapid evaporation will more speedily and more safely refrigerate, than simple water.

I do not wish to make this article too lengthy, but in answer to the query as to the manner of administering artificial food, I call attention to

THE ARM-PIT OR MILK-WARM NURSING BOTTLE,

(fig. 4, p. 239.) This holds about enough for two ordinary nursings of a child. Its lines are patterned after plaster of Paris moulded to the arm-pit, and is intended there to be worn next to the person. It will be maintained in its position by the corsets and dress; but if necessary, the tube strap attached to the upper ends at *a*, can be put over either shoulder. The same strap is used to hang it on the cradle when child is there lying. The special object of said bottle is to insure the child its artificial food at blood or milk warmth; many of the gastric troubles of children being directly caused by the various and unnatural temperatures, of the food to them given, when traveling, etc., it sometimes being too hot, but more often too cold. When traveling, with bottle in position it will not disturb the contour of the wearer's dress. No "outsider"

would know of its presence, but upon demand of child the mouth end of No. 3 tube can be withdrawn from the dress and child fed at proper temperature. None of the person being exposed, a stranger would not know but that the milk came from the breast. At *a* are valve straps, which prevent the gravity pressure of the atmosphere from ejecting the milk at *b*, where is an out valve assisting to maintain in position the milk in the bottle. By the suction of child at mouth piece, this tension is removed, and the milk flows easily. The straps at *a*, prevent its flowing too easy, but when found to be too taut, a slight displacement of the strap at *a*, with finger nail, will admit enough air to make easy again the flow of milk. A rubber bulb, fig. 16, is at one end *a*, attachable to the glass connecting valve-piece, at *b*, and at its other end to the end of tube fig. 3. This is done when it is time to cleanse the bottle. The straps at *a* of fig 4, are then turned to one side, and he bottle immersed in hot water and by the manipulation of the bulbs, as with any bulb syringe, the whole apparatus is immediately and perfectly cleansed. This does away with the troublesome fermentive filth, as found in all other nursing tubes and bottles. The connecting glass at *b*, is impacted in the one side of a rubber cork, so that the bottle, if laid on table, is capable of being emptied by suction whilst so lying. This cork is movable, and the bottle can be rinsed or washed through *a*, at any faucet.

The young babe should not be fed oftener than every two hours and regular intervals should be observed. Just as a laboring man knows by his stomach when it is 6 or 12 o'clock, so a regular regime will establish a proper nature, even in the babe. Its digestive organs will learn with confidence to effect its churning, knowing that for a certain time they will not be interrupted. It should never be fed to perfect satiety—a little surplus gastric juice being better than surplus food.

A babe of 6 months should be fed every 3 hours during the day, and twice during the night—6 times in the 24 hours. If from heat or bad management the babe cries for food during the intervals, water, or barley water, then should be given it.

Instruments reported by Dr. Clendinen at the April meeting of the Bergen District Society, and by resolution of the Society communicated to the Standing Committee.

The Nipple Maker.

Figs. 1 and 2.

This is of flint glass, blown in a mould, and is 1¼ in. high by a base of 1¼ in. There is a valve strap over foramen at *a*, and below this line is a gentle swell by which it is anchored when introduced into the rubber-lined foramen *b*, of No. 2. The larger swell, just above its base, prevents its too deep entrance into foramen *b*, and allows the nipple to somewhat expand, when past the neck; thus helping to maintain the glass in position,—at the same time that by this continued expansive traction, a proper nipple is formed. Adjust fig. 1 into the foramen *b*, of fig. 2, and then adjust the base of fig. 1. to the site of future nipple, and next, by depression of the rubber discs of fig. 2, produce a vacuum in fig. 1. Day by day this increases in tensity, until a nipple is formed large enough to properly fill the glass. On each occasion of the application, after said vacuum has been obtained, fig. 2. is gently withdrawn from fig. 1, it being left to breast attached. It can be worn for hours; it is light and but little in the way—less than what I last year devised—the improvement consisting as above. If depression exists where there should be a nipple, its application should commence at or before the fourth month and continue. If there is only a simple lack of proper fullness a few days prior to, or immediately upon confinement will suffice.

The Nurser.

Figs. 2 and 3.

This, fig. 2, is complete with the connection of tube, fig. 3, whose mouthpiece is just below *a*, where it connects with said tube by means of glass connector, to which is attached a rubber strap, thus forming a valve in immediate proximity to the child's mouth. The object of which is that the child shall have less vacuum to make, less length of traction being necessary, in consequence of the tube being constantly full of milk. This specially remedies the trouble

where a great many weak babies—consequent upon their inability or unwillingness to create again and again a vacuum throughout the ordinary length of a nursing tube—are fed by a spoon or the drippings of a bottle, being thus deprived of the benefit of suction. At *c*, is the bottom out-valve of the glass-rubber bulb. Fig. 2. *a*, at the top, represents a smaller glass rubber-strapped valve to be used as an air-valve or pet cock; *b*, represents the foramen, rubber-lined for nipple; when adjusted to which, the rubber discs of both sides are compressed by the fingers, and upon expulsion of air at *a*, a vacuum is obtained. The nurser will now maintain its position, and the expanded end of nipple will so open the sphincters that the milk accumulates in the bulb, until withdrawn by suction of the child. Whenever it is desired to remove the glass, or to lessen the vacuum, slight displacement of the rubber strap at *a* will relieve the same, and, on the other hand, if the suction of child is not strong enough, in consequence of scarcity of milk or other cause, the repeated depressions of discs by mother or nurse will assist.

The special advantages of this nurser are the facts: 1st. Instead of pinching the end of nipple, as ordinary glasses do, it allows it to expand; thus it not only does not pain sore nipples, but instead, allows the application of demulcent astringent solutions to the inner side of their sore sphincters. 2d. The feeblest child can be nursed in consequence of but slight suction being required, and of the mother being able to assist if necessary. 3d. The glass once adjusted will stay there, and will not slobber, and *the person* need not therefore in traveling, on boat, or car, or elsewhere, be exposed, nor will the clothes be soiled. 4th. The teething babe can bite on the nipple, of solid, heavy rubber on glass. 5th. By immersing it in water and alternately applying thumb of one hand to foramen *b*, whilst with the index finger of the other hand on pet cock, and thumb and second finger on discs, water can be drawn in at *b*, and squirted out at mouth-piece of tube, and thus thoroughly cleansed.

Nipple Glass.

Fig. 7.

This is a small, light nipple glass, designed for an ordinary nipple The advantages possessed are that the neck at *a*, is diagonal in its lines; thus preventing direct constriction.

The bulb swell allows the expansion of duct mouths, and assists in maintaining it upon the breasts, at the same time that there is sufficient

cubic space for the accumulation of some milk to be removed by way of rubber-strap valve at *b*, through rubber tube which has valve glass at *c*, connecting with mouth-piece; and it does not, as other glasses do, pinch the nipple,—but whilst maintaining its position, does not allow slobbering of milk, nor necessitate the exposure of person. Hence many women may use it who would not use the ordinary glass.

The Breast Pump.

Figs. 5 and 2.

Fig. 5, has in its mouth above *a*, a valve-piece of hard rubber with rubber strap. When adjusted in foramen *b*, of fig. 2, figs. 5 and 2 form the breast pump. It is then at *b*, of fig. 5, set over the nipple which enters at neck below *a*, of fig. 5. Six arms run from the line of *a*, at regular intervals to the periphery of circle *b*, thin rubber filling their interstices and conforming to their lines, which at the end are like baby lips—the convex surfaces facing inward toward each other, when quiescent, and whilst in alternate expansion and contraction, simulating, with extra power, the action of child's mouth lips. In the first, by flattening pressure upon breast by operator, and in the second, by withdrawing and suction caused by relief of indentation of rubber discs, of fig. 2; the areola nipple milk has been conveyed into the nipple and the compression at neck below *a*, has then forced it to the front; to be by suction taken through hard rubber valve into the bulb, and from thence to be, by valve at *c*, ejected upon next compression of rubber discs. The nipple space at *a*, of fig. 5, expands, and has a capacity for a large nipple; the alternate thick and thin rubber at neck below *a*, admitting and holding any size.

The Blood Transfusor.

Blood transfusion has been practiced off and on from the earliest days of medical record, and, during the last 200 years, it has had many able advocates, but has never met with popular success. As surgeon in the late civil war, and since, for traumatic and other cases, myself, and many others, have often felt regretful chagrin that the willing giver was not always easy to find, and that if found, we did not possess satisfactory apparatus wherewith we could see what we were doing, and be sure that we were not forcing air or coagula into the helpless patient, thus directly causing his demise. I imagine that my apparatus most nearly answers these requirements. It is capa-

ble of venous transfusion, but is designed for arterio-venous transfusion. Folli, of Italy, in 1652, inaugurated this idea, and it was practiced by Daniel, of Leipsic, in 1664. The character of the apparatus could not, however, at that date, have the advantage of the ability we have since acquired, to make rubber simulate the expansive and contractive power of the blood vessel in its valvular action—nor was it then, nor till now possible to have glass blown to the required moulds. It is to these points of advantage that I specially call attention. The blood passing from the artery of the giver to the vein of the receiver is visible to the eye of the operator, and the pulsation of the artery is indicated in the tubing and on the discs of the glass bulb, No. 6, where the fingers of the operator may keep time with it, assisting as required. In description of operation, you will see how the patient is secured against the entrance of air, or exposure of blood to the same, and how by regulation of temperature and the conformity,and composition of instrument no pellets of lymph can enter the circulation. The first thing to do is to see that the giver and receiver are placed in position, side by side, but face to face, with arms over vessel so oblong-shaped as to admit immersion of arms, and of hand of operator. Rubber bands five inches wide are adjusted on each arm, and the water is notable by therm. 104° and kept at full blood heat. No. 5, is now placed in the water, after the connectors, fig. 11, have been entered, the tubes and the discs are so manipulated as to discharge air out of pet or air-cock *b*, and to pump into bulb—water, through tube having rubber strap over foramen of glass connector, viz.: the in or receiving valve at *d*. The current is now forced through out-valve at *c*, and tubes and all being full of water, the apparatus is allowed to lie in the water, until the water-warmed canula, fig. 10, has been introduced into the vein of the receiver, and canula, fig. 9, then introduced into artery of the giver. Canula 9, is now entered connector, fig. 11, of *d* tube, and the rubber band adjusted over all. The compression of and then relaxation by fingers of operator of the rubber discs of bulb now commences the discharge of the water, and its replacement by entrance of arterial blood, with pulsation in accordance. The connector end of *c* tube is now held ready to enter canula, fig. 10, so soon as it is apparent that the arterial current has satisfactorily expelled water (and air if present) from bulb. As the blood comes from mouth of connector it is allowed to throw canula, 10, full, and the blood is overflowing as it is firmly entered. The band is now on the receiver's arm, drawn over

bulb, etc., immersed, and the operation proceeds, the discs being depressed as required. An ordinary full depression of disc is equal to the transfusion of f℥ii. The bulb is held in position so that by *d* tube, blood enters at the side and by *c* it leaves at the bottom, whilst the air-cock is at the top and controlled by the index finger, whereas the thumb on the one side and the second finger on the other attend to the discs. On the side opposite to *d*, is foramen *a*, in which is impacted a $\frac{3}{16}$ thick piece of rubber, in which is a fine slit, admitting on pressure the blunt pointed canula, fig. 8, which is intended to convey, when demanded, Littel's, or other alkaline solution,—ammonia or other. The point is that the operator can see what he is doing—and can emit air, or introduce alkali into the blood, when necessary, without interrupting the transfusion, which, if done, favors coagulation. This last is, I imagine warded against, and the presence of air denied to an extent satisfactory, even to Roussel, by the regulation of temperature and the transfusion under water.

The Milk Transfusor.

This is substantially the same as already described, except that the end of tube attached at in-valve *d*, can be immersed in the vessel containing the milk. For instance, the pitcher being used, as described by Prof. T. Gaillard Thomas, in his very able paper, in N. Y. *Medical Journal*, May, 1878. It would, however, be manifestly better, where possible, to use immediate transfusion—thus avoiding change of temperature and the chemical action of air or of its animal or fungoid contents upon the milk. The object is, when it may prove practical, to approximate the cow and patient upon the same level and to use canula, fig. 9, as a catheter, introduced into a teat of the cow. The sphincter occupies an average depth of $\frac{3}{8}$ of an inch, and f℥viii can readily be obtained from the reservoir of the one teat. In fact, the entire milk of a cow can be thus drained in half the time of ordinary milking, and the cow will be quiet whilst it is being done.

The annexed table shows the average composition of the most important kinds of milk:

	Woman.	Cow.	Goat.	Sheep.	Ass.	Mare.
Sugar........	4.8	4.6	4.3	5.4	6.4	7.3
Butter....	2.9	3.6	3.4	2.4	1.3	2.1
Cheesy Matter....	2.9	5.1	4.4	4.8	1.9	1.5
Salty.............	2.21	0.6	0.8	0.9	—	
Total............	10.9	13.9	12.9	13.5	9.6	10.9

For immediate transfusion, the goat would be most generally in command and could be driven to the bedside of the patient upon any floor. In this case canula, fig. 8, could be used in its teat, or last but not least, *fig. 5 could be used upon the breast of a healthy—rich-milk woman*, who could at any time and at any place be found, and would not only co-operatively be more tractable, but who, although not supplying material so strong as cow's milk, would nevertheless furnish one more to the manner-born, and here I will say that the comparative weakness of *human* milk should by no means ostracise it. When the wounded man on the field cries for water, its first use, after the local relief of dry throat and stomach, is to pass into the circulation, and by its volume relieve the attrition in the vessels suffering from semi-vacuum. For transfusion in traumatic cases, the first demand then is for volume of fluid, in order that nature may divide up and disseminate what has been left of normal matter. The next requirement is, that the material shall be of a character capable of maintaining the normal heats in the various sections. Third, is the requirement that the material shall be such as of which new tissues can be formed. The nearest approach to this is to recognize the patient as in his second childhood—and now to repair his frame with the same material of which, in first childhood, it was built. Feed him not with too large doses, but oftener. That could be done with the stronger, but at the same time abnormal milks. Fig. 5, has already been described in article on breast pump. It simulates the action of the child. Its nipple space is expanded with capacity for large nipple, but the neck at *a* is by means of the 6 rubber ribs and their intermediate thin rubber, enabled to constrict in accordance with the size of nipple and to play the part of the tongue against roof of mouth, in its tractive, vacuum squeeze of the nipple; whilst the circle *b*, simulates the action of the mouth lips, only with more power, as needed. Enough milk can readily be gotten from a breast, and there will be no transfusion of air. If any enters the bulb it will be out-forced at the pet cock *b*. After refrigeration at cerebral base, to regulate temperature, diuretic, alcoholic stimulation should be used just prior to the transfusion, in order to facilitate its rapid dissemination, and to incite the heat and tone needed at the time. Thus will be avoided the extent of shock and consequent rigor. The capacity of this instrument is f℥ii to each compression of the discs; so that the amount of fluid transfused can be easily calculated.

The Light Aspirator.

This is formed of fig. 6, the glass rubber bulb, with the tubing *d*, connected by fig. 12, with proper sized needle—13, 14, or 15. When inserted in part, the discs are compressed and relaxed, thus creating a vacuum by the outgoing of air at pet cock *b*; and the incoming of fluid through tubes attached at in-valve *d*, is the result. The out-valve at *c*, will allow the discharge of fluid—upon compression—into vessel. Whenever proper, another tube, one end of which is immersed in a vessel containing carbolic acid solution, or other medicament, may at the other end have one of the needles attached, which is likewise introduced into the cavity. The working of the aspirator will now pump the solution through, and then leave the cavity as closely, and comparatively dry, as is thought proper. This aspirator is not capable of creating vacuum sufficient to remove through needles any very heavy fluid. I have used it with crooked canula, as fig. 10, passed through tympanum and thereby removed purulent matter of middle ear. I have used it on the bladder, and I have used No. 13 needle on psoas abscess successfully. For all light work it is specially adapted and is handy to carry. You can see what you are doing and not be annoyed by the jar of piston work.
